SECTION 2

# Development of Remedial Action Objectives

This section describes the RAO development process and establishes RAOs for the Inboard Area sites that require remedial action (i.e., have residual contaminants that are greater than their comparator values). The development of RAOs is the first phase of the feasibility study process and is, therefore, a critical prerequisite to the development of remedial alternatives. The RAOs are general descriptions of the goals the remedial actions are expected to accomplish, such as protecting human health and the environment by eliminating chemicals of concern and/or reducing or controlling exposures to human and ecological receptors during the development and maturation of the wetland.

## 2.1 RAO Development

The RAOs are developed in this FFS to provide a basis for evaluating the ability of the remedial alternatives, to comply with ARARs, and to achieve goals of protecting human health and the environment in the future wetland. The RAOs are quantitative and qualitative expressions of goals for protecting human health and the environment. Protection of human health and the environment in the future wetland can be accomplished by reducing the concentrations of residual contaminants that are greater than their comparator values or by controlling or eliminating the exposure of receptors to residual contaminants that are greater than their comparator values. Given these two primary methods for protecting human health and the environment at the Inboard Area sites, the RAOs establish both contaminant-specific and exposure-specific objectives. Together, the contaminants-specific and exposure-specific objectives consider the contaminants and media of interest, the possible future wetland receptors, and the exposure pathways.

Chemical-specific, location-specific, and action-specific ARARs and performance standards identified for this FFS are presented in Section 2.2. RAOs are identified in Section 2.3.

Analytical data and other information used to facilitate the development of RAOs for this FFS were obtained from the following references:

- RI (IT, 1999a)
- 1998 Interim Removal Action Data Report (IT, 1999b)
- 1999 Interim Removal Action Data Report (IT, 2000)
- Remedial Design Investigation (FW, 2000)
- Human Health and Ecological Risk Assessment (U.S. Army, 2001).

## 2.2 Applicable or Relevant and Appropriate Requirements

The ARARs listed in the following sections have been identified as potential ARARs; the determination of ARARs is an ongoing process, with a final determination of all ARARs to be presented in the BRAC Property RAP. Therefore, reference to the term "ARARs" in subsequent sections of this report should infer the ARARs are only potential in nature at this

stage of the CERCLA process and will continue to evolve through the RAP. Applicable or relevant and appropriate requirements may be added, deleted, or have a revised status as the result of the document revision process.

Pursuant to Section 121(d)(1) of CERCLA, remedial actions must attain a degree of cleanup, which is protective of both human health and the environment, and they must comply with ARARs. Additionally, remedial actions that leave hazardous substances, pollutants, or contaminants onsite must meet standards, requirements, limitations, or criteria that are applicable or relevant and appropriate requirements. Federal ARARs include requirements under any federal environmental law, while state ARARs include promulgated requirements under state environmental or facility-siting laws that are more stringent than federal ARARs and that have been identified as ARARs by the State of California in a timely manner. To be an ARAR, the requirement must be either (EPA, 1988a):

- "Applicable" requirements, which are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

  Under CERCLA regulation, onsite actions need comply only with the substantive aspects of ARARs, not with corresponding administrative requirements (such as but not limited to permits, recordkeeping, and reporting). However, substantive components of apparently administrative requirements, such as recordkeeping, are potential ARARs. For example, a regulation that describes required reports can include specific measures of remediation performance that must be made. The report is not a potential ARAR, but the specific measures needed to document remediation performance are substantive requirements and may be ARARs.

- "Relevant and appropriate" requirements, which are those cleanup standards that are standard or other substantive environmental requirements promulgated under federal or state law that, while not specifically "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, nevertheless addresses problems or situations sufficiently similar to those encountered at the site to indicate their use. A requirement must be both relevant and appropriate to be designated an ARAR. Applicable or relevant and appropriate requirements are identified on a site-specific basis from information about site-specific chemicals, specific actions that are being considered, and specific features of the site location.

For a state requirement to be considered an ARAR, it must be:

- Legally enforceable
- Generally applicable to all circumstances covered by the requirement, not just Superfund sites
- More stringent than the federal regulation

Substantive requirements pertain directly to actions or conditions in the environment. They include restrictions for exposure to certain types of hazardous substances

(e.g. chemical-specific ARAR), technology-based requirements for actions (e.g., action-specific ARARs), and restrictions on activities in certain locations (e.g., location-specific ARARs). For any onsite remedial activity, the administrative portions of the environmental standards criteria, or limitations are not ARARs because CERCLA, Section 121(e) exempts these actions from permitting requirements. This permit exemption applies to all administrative requirements, whether or not they are styled as "permits." Administrative requirements include the approval of or consultation with administrative bodies, issuance of permits, documentation, reporting, recordkeeping, and enforcement.

The three categories of ARARs are as follows:

- Chemical-Specific ARARs are numerical values that represent a health-based or risk-based standard or the results of methodologies which when applied to site-specific conditions are used to establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.
- Location-Specific ARARs are restrictions on the conduct of activities solely because the site occurs in certain environmentally sensitive areas. Examples are wetlands, floodplains, endangered species habitat, or historically significant resources.
- Action-Specific ARARs are technology-based or activity-based requirements or limitations on actions taken with respect to hazardous waste.

A requirement may not meet the definition of ARAR as defined above, but still be useful in determining whether to take action at a site or to what degree action is necessary. This can be particularly true when there are no ARARs for a site, action, or contaminant. Such requirements are called to-be-considered (TBC) criteria. TBC materials are nonpromulgated advisories or guidance issued by federal or state government that are not legally binding, but may provide useful information or recommended procedures for remedial action. Although TBCs do not have the status of ARARs, they are considered along with ARARs to establish the required level of cleanup for protection of health or the environment.

Section 121 (d)(4) of CERCLA provides six specific circumstances in which potential ARARs may be waived. These waivers apply only to meeting ARARs with respect to remedial actions onsite. Other statutory requirements, such as remedies being protective of human health and the environment, cannot be waived. Currently, it is not envisioned that any waivers will be requested for the BRAC Property sites; however, the following circumstances are summarized below for sake of completeness.

- Interim Measures: The remedial action selected is only part of a total remedial action that will attain such a level or standard of control when completed (Section 121 (d)(4)(A)).
- Greater Risk to Human Health and the Environment: Compliance with such requirement at the facility will result in greater risk to human health and the environment than alternative options (Section 121 (d)(4)(B)).
- Technical Impracticability: Compliance with such a requirement is technically impracticable from an engineering perspective (Section 121 (d)(4)(C)).

- Equivalent Standard of Performance: The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation, through use of another method or approach (Section 121 (d)(4)(D)).
- Inconsistent Application of State Requirements: With respect to a state standard, requirement, criterion, or limitation, the state has not consistently applied the standard, requirement, criterion, or limitation in similar circumstances at other remedial actions (Section 121 (d)(4)(E)).
- Fund Balancing: The Hazardous Substance Response Fund (Fund) waiver may apply when the selection of a remedial action that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration and the availability of amounts from the Fund to respond to other sites which present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats (Section 121 (d)(4)(F)). Since the U.S. Army is the lead agency for HAAF (i.e., remedial activities are not Fund financed), this waiver is not available to the HAAF remedial actions.

The ARARs and performance standards for this FFS were developed using the following guidelines and documents:

- *CERCLA Compliance with Other Laws Manual, Part I: Interim Final* (EPA, 1988b)
- *CERCLA Compliance with Other Laws Manual, Part II: Clean Air Act and Other Environmental Statutes and State Requirements* (EPA, 1989)
- *California State Water Resources Control Board ARARs Under CERCLA* (SWRCB, 1992).

### 2.2.1 Chemical-Specific ARARs and TBCs

The chemical-specific ARARs and TBCs for HAAF can divided be into two categories: those that affect cleanup goals and those that affect soil and sediment characterization and disposal.

Because there are no promulgated chemical-specific ARARs that can be applied as soil or sediment cleanup goals, a variety of TBC criteria have been considered. The chemical-specific TBCs for metals, pesticides, SVOCs, petroleum hydrocarbons, VOCs, and PAHs for both Inboard and Upland sites are presented in Table 2-1. These concentrations are not based on promulgated regulations, but are based on the following sources:

- Metals: Ambient concentrations for Hamilton, Effects Range Lows (Reference: Long, E.R, D.D. MacDonald, S.L. Smith, and F.D. Calder, 1995, "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments," Environmental Management, 19:81-97), and RWQCB Draft Staff Report "Beneficial Reuse of Dredge Materials: Sediment Screening and Testing Guidelines," May 2000
- Pesticides: RWQCB Draft Staff Report "Beneficial Reuse of Dredge Materials: Sediment Screening and Testing Guidelines," May 2000 and target concentrations (concentrations used to calculate risk during the risk assessment)

- SVOC (dibenzofuran): target concentration (concentration used to calculate risk during the risk assessment)
- Petroleum hydrocarbons: RART values
- VOC (xylenes); target concentration (concentration used to calculate risk during the risk assessment)
- PAHs: Effects Range Lows and RWQCB Draft Staff Report "Beneficial Reuse of Dredge Materials: Sediment Screening and Testing Guidelines," May 2000

The chemical-specific ARARs that affect soil and sediment characterization and disposal include the RCRA requirements for identification of hazardous waste found in Title 22 of the California Code of Regulations, Division 4.5, Chapter 11. A hazardous waste is a RCRA hazardous waste if it exhibits any of the characteristics of ignitability, corrosivity, reactivity, or toxicity identified in 22 66261.21, 66261.22(a)(1). 66261.22(a)(2), 66261.23, and 66261.24(a)(1) or if it is listed as a hazardous waste in article 4 of Chapter 11. Most of the waste determinations at HAAF will likely focus on whether the wastes generated at the site (e.g., excavated soil or sediment) could be classified as toxicity characteristic waste as defined by contaminant concentrations that exceed the toxicity characteristic leaching procedure (TCLP) limits. These limits are presented in 22 CCR 66261.24 (a)(1).

Under the California RCRA program, wastes can be classified as non-RCRA, State-only, hazardous wastes if they exceed the Soluble Threshold Limit Concentration (STLC) or the Total Threshold Limit Concentration (TTLC) values listed in 22 CCR 66261.24(a)(2). If remediation wastes generated at HAAF are characterized as hazardous waste, the regulations that govern the treatment, storage, and disposal of hazardous waste will be considered ARARs.

The numerical values presented in 22 CCR 66261.24 (a)(1) and (a)(2) are not considered cleanup goals but are compared to contaminant concentrations in excavated materials to determine how the material should be managed. In other words, the toxicity characteristic waste criteria should not be compared to in situ contaminant concentrations in soil or sediment but rather to the soil or sediment after it has been excavated (i.e., after the waste has been "generated").

If contaminant concentrations in excavated materials are less then the TCLP, TTLC, or STLC but still contain contaminants that could cause degradation of waters of the state, these materials may be considered a designated waste (See Table 2-3 for a more detailed discussion). Based on prior excavation and offsite disposal actions conducted in 1998 and 1999 at the HAAF site, it is anticipated that future excavated materials will not exceed the hazardous waste toxicity concentrations and therefore not be considered a hazardous waste. The waste may however be considered a designated waste and would require to be handled as such (e.g., disposed of in a Class II landfill - See Table 2-3).

### 2.2.2 Location-Specific ARARs

The location-specific ARARs for HAAF are summarized in Table 2-2.

### 2.2.3 Action-Specific ARARs

The action-specific ARARs for HAAF are summarized in Table 2-3.

## 2.3 Identification of Remedial Action Objectives

RAOs are developed in this section for each Inboard Area site where the FFS (Section 1.0) identifies COCs (i.e., sites where residual contamination was detected above comparator values). The RAOs constitute the basis for the development of remedial alternatives which are designed to be protective of human health and the environment during the development and maturation of the wetland.

The following subsections contain summaries of the RAOs for each Inboard Area site requiring remedial action. Exposure-specific RAOs represent the receptor that is most sensitive to the listed COC within the habitats and subhabitats that are evaluated for each site. These habitats include estuarine subhabitats (high marsh, subtidal, and intertidal) and the applicable human health scenario (recreational uses). For the Building 82/87/92/94 Area, PDD-Unlined, and Spoil Piles A, B, and N freshwater receptors are also considered. The most sensitive receptor was determined by:

- Identifying COCs at the site,
- Determining which receptors have HQs greater than 1.0 (or ILCR greater than $1x10^{-6}$) for each habitat and subhabitat, and
- Determining which receptor in a habitat or subhabitat had the lowest target concentration (i.e., is the most sensitive to the COC in that habitat)

### 2.3.1 Former Sewage Treatment Plant

The FFS identifies pesticides as the COCs at the FSTP, which would pose a risk to human health or ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for the FSTP are to prevent or mitigate the potential ecological and/or human health risks associated with soil containing pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of black rail to soil containing DDE and DDD
- Exposure of the amphipod to soil containing alpha-chlordane, gamma-chlordane, DDD, DDT, dieldrin, and endosulfan sulfate
- Human ingestion of fish containing gamma-chlordane and dieldrin

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-4.

### 2.3.2 Building 26

The FFS identifies total petroleum hydrocarbon measured as diesel as the COC at Building 26, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Building 26 are to prevent or mitigate potential ecological risk associated with petroleum hydrocarbons.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing petroleum hydrocarbons as diesel during the development and maturation of the wetland. If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-5.

### 2.3.3 Building 35/39 Area

The FFS identifies pesticides as the COCs at the Building 35/39 Area, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the Building 35/39 Area are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing DDD and DDT
- Exposure of the algae and bay shrimp to soil containing DDT
- Exposure of the black rail to soil containing DDD and DDE

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-6.

### 2.3.4 Building 41 Area

The FFS identifies TPH measured as diesel and PAHs as the COCs at the Building 41 Area, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Building 41 Area are to prevent or mitigate potential ecological risk associated with petroleum hydrocarbons and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing TPH measured as diesel, 2-methylnaphthalene, acenaphthene, fluoranthene, fluorene, naphthalene, and phenanthrene
- Exposure of the pickleweed to soil containing acenaphthalene and naphthalene

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-7.

### 2.3.5 Building 82/87/92/94 Area

The FFS identifies metals as the COCs at the Building 82/87/92/94 Area, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Building 82/87/92/94 Area are to prevent or mitigate potential ecological risk associated with metals.

Exposure-specific RAOs are to prevent:

- Exposure of the salt marsh harvest mouse to soil containing barium
- Exposure of the amphipod to soil containing barium and beryllium
- Exposure of the algae and mosquitofish to water containing barium and beryllium

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-8.

### 2.3.6 Building 86

The FFS identifies metals and PAHs as the COCs at the Building 86 Area, which would pose a risk to ecological or human receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for Building 86 are to prevent or mitigate potential ecological or human risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing beryllium, cadmium, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene, benzo(b)fluoranthene, fluoranthene, phenanthrene, and pyrene
- Exposure of black rail to soil containing chromium and lead
- Exposure of the pickleweed to soil containing cadmium, chromium, and benzo(a)pyrene
- Human exposure to benz(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-9.

### 2.3.7 Perimeter Drainage Ditch

The FFS identifies metals and pesticides as the COCs at the perimeter drainage ditch, which would pose a risk to human health or ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for the PDD are to prevent or mitigate potential ecological and/or human health risks associated with metals and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing beryllium, DDD, DDT, and dieldrin

- Exposure of the black rail to soil containing DDD and DDE
- Exposure of bay shrimp and algae to soil containing DDT
- Exposure of the algae, sediment invertebrate, and mosquitofish to soil containing beryllium
- Exposure of the snipe to soil containing DDD
- Exposure of the sediment invertebrate to soil containing DDE, DDT, and dieldrin
- Human ingestion of fish containing dieldrin

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-10.

## 2.3.8 Perimeter Drainage Ditch Spoils Pile A

The FFS identifies metals as the COCs at PDD Spoils Pile A, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile A are to prevent or mitigate potential ecological risk associated with metals and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the pickleweed to soil containing zinc
- Exposure of the amphipod to soil containing beryllium, zinc, DDE, and DDT
- Exposure of the algae to water containing beryllium
- Exposure of the sediment invertebrate to water containing DDE and DDT

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-11.

## 2.3.9 Perimeter Drainage Ditch Spoils Pile B

The FFS identifies metals as the COCs at the PDD Spoils Pile B, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile B are to prevent or mitigate potential ecological risk associated with metals and DDT.

Exposure-specific RAOs are to prevent:

- Exposure of the salt marsh harvest mouse to soil containing copper
- Exposure of the pickleweed to soil containing mercury and zinc
- Exposure of the amphipod to soil containing cadmium, copper, mercury, silver, zinc, and DDT
- Exposure of the black rail to soil containing copper

- Exposure of the bay shrimp and algae to soil containing copper and silver
- Exposure of the snipe to water containing mercury
- Exposure of the algae to water containing cadmium and silver
- Exposure of the sediment invertebrate to water containing copper

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-12.

### 2.3.10 Perimeter Drainage Ditch Spoils Pile D

The FFS identifies pesticides as the COCs at the PDD Spoils Pile D, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile D are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing DDE and DDT
- Exposure of sediment invertebrate to water containing DDE and DDT

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-13.

### 2.3.11 Perimeter Drainage Ditch Spoils Pile E

The FFS identifies pesticides as the COCs at the PDD Spoils Pile E, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile E are to prevent or mitigate ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing DDE, and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-14.

### 2.3.12 Perimeter Drainage Ditch Spoils Pile F

The FFS identifies metals and PAHs as the COCs at the PDD Spoils Pile F, which would pose a risk to human health and ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for the PDD Spoils Pile F are to prevent or mitigate potential human health and ecological risk associated with metals, PAHs, and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of bay shrimp and algae to soil containing DDT
- Exposure of the salt marsh harvest mouse to soil containing cobalt and manganese
- Exposure of the pickleweed to soil containing arsenic, lead, nickel, zinc, benzo(a)pyrene, and acenaphthene
- Exposure of the algae to soil containing manganese
- Exposure of the black rail to soil containing lead, DDD, and DDE
- Exposure of the amphipod to soil containing arsenic, beryllium, cadmium, cobalt, lead, manganese, nickel, zinc, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, DDD, and DDT
- Human exposure to arsenic, benz(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-15.

## 2.3.13 Perimeter Drainage Ditch Spoils Pile G

The FFS identifies pesticides as the COCs at the PDD Spoils Pile G, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile G are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing DDT
- Exposure of the black rail to soil containing DDE

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-16.

## 2.3.14 Perimeter Drainage Ditch Spoils Pile I

The FFS identifies beryllium as the COC at PDD Spoils Pile I, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile I are to prevent or mitigate potential ecological risk associated with beryllium and pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing beryllium, DDD, and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-17.

### 2.3.15 Perimeter Drainage Ditch Spoils Pile J

The FFS identifies pesticides as the COCs at PDD Spoils Pile J, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile J are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing DDD, DDE, and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, then contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-18.

### 2.3.16 Perimeter Drainage Ditch Spoils Pile K

The FFS identifies pesticides as the COCs at PDD Spoils Pile K, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile K are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing DDE and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-19.

### 2.3.17 Perimeter Drainage Ditch Spoils Pile L

The FFS identifies metals as the COCs at PDD Spoils Pile L, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile L are to prevent or mitigate potential ecological risk associated with metals and DDT.

Exposure-specific RAOs are to prevent:

- Exposure of the pickleweed to soil containing cobalt
- Exposure of the amphipod to soil containing barium, cobalt, lead, and zinc

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-20.

### 2.3.18 Perimeter Drainage Ditch Spoils Pile M

The FFS identifies pesticides as the COCs at PDD Spoils Pile M, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile M are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing DDE and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-21.

### 2.3.19 Perimeter Drainage Ditch Spoils Pile N

The FFS identifies lead and pesticides as the COCs at PDD Spoils Pile N, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile N are to prevent or mitigate potential ecological risk associated with lead and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing DDT
- Exposure of the black rail to soil containing DDE
- Exposure of the sediment invertebrate to water containing lead, DDE, and DDT

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-22.

### 2.3.20 Onshore Fuel Line – 54-Inch Line

The FFS identifies gasoline as the COC at the ONSFL 54-Inch Line, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the ONSFL 54-Inch Line are to prevent or mitigate potential ecological risk associated with gasoline.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as gasoline.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-23.

### 2.3.21 Onshore Fuel Line – Hangar Segment

The FFS identifies petroleum hydrocarbons and PAHs as the COCs at the ONSFL Hangar Segment, which would pose a risk to human health and ecological receptors if these

receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for the ONSFL Hangar Segment are to prevent or mitigate potential human health and ecological risk associated with petroleum hydrocarbons and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing TPH measured as JP-4 and gasoline, acenaphthene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, benzo(b)fluoranthene, fluoranthene, fluorene, naphthalene, pyrene, ethylbenzene, indeno(1,2,3-cd)pyrene, and xylenes
- Exposure of Salmonid to soil containing ethylbenzene
- Exposure of algae to soil containing ethylbenzene
- Exposure of bay shrimp to soil containing ethylbenzene and xylenes
- Human exposure to benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene, debenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-24.

## 2.3.22 Onshore Fuel Line – Northern Segment

The FFS identifies petroleum hydrocarbons (gasoline) as the COCs at the ONSFL Northern Segment, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the ONSFL Northern Segment are to prevent or mitigate potential ecological risk associated with gasoline.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as gasoline.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-25.

## 2.3.23 Northwest Runway Area

The FFS identifies metals as the COCs at the Northwest Runway Area, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the Northwest Runway Area are to prevent or mitigate potential ecological risk associated with metals and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the pickleweed to soil containing boron
- Exposure of the amphipod to soil containing beryllium

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-26.

## 2.3.24 Revetment 1

The FFS identifies metals and PAHs as the COCs at Revetment 1, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 1 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the black rail to soil containing lead
- Exposure of the amphipod to soil containing barium, cadmium, acenaphthene, anthracene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, and phenanthrene

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-27.

## 2.3.25 Revetment 2

The FFS identifies metals and PAHs as the COCs at Revetment 2, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 2 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the black rail to soil containing lead
- Exposure of the amphipod to soil containing cadmium and dibenz(a,h)anthracene

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 28.

## 2.3.26 Revetment 3

The FFS identifies metals as the COCs at Revetment 3, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 3 are to prevent or mitigate potential ecological risk associated with metals.

Exposure-specific RAOs are to prevent:

- Exposure of the salt marsh harvest mouse to soil containing copper and manganese
- Exposure of amphipod and algae to soil containing barium and manganese

- Exposure of the pickleweed to soil containing manganese
- Exposure of bay shrimp and algae to soil containing copper

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-29.

## 2.3.27 Revetment 4

The FFS identifies metals and PAHs as the COCs at Revetment 4, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 4 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing cadmium, acenaphthene, fluorene, and phenanthrene
- Exposure of the black rail to soil containing lead

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-30.

## 2.3.28 Revetment 6

The FFS identifies PAHs and petroleum hydrocarbons as the COCs at Revetment 6, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 6 are to prevent or mitigate potential ecological risk associated with PAHs and petroleum hydrocarbons.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as gasoline, 2-methylnaphthalene, acenaphthene, and flourene.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-31.

## 2.3.29 Revetment 7

The FFS identifies metals and PAHs as the COCs at Revetment 7, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 7 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the black rail to soil containing lead

- Exposure of the amphipod to soil containing 2-methylnaphthalene, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, phenanthrene, and pyrene.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-32.

## 2.3.30 Revetment 11

The FFS identifies copper as the COC at Revetment 11, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 11 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent exposure of the salt marsh harvest mouse to soil containing copper.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-33.

## 2.3.31 Revetment 12

The FFS identifies copper as the COC at Revetment 12, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 12 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent exposure of the salt marsh harvest mouse, bay shrimp, and algae to soil containing copper.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-34.

## 2.3.32 Revetment 13

The FFS identifies metals and PAHs as the COCs at Revetment 13, which would pose a risk to human health and ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for Revetment 13 are to prevent or mitigate potential human health and ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the black rail to soil containing lead

- Exposure of the amphipod to soil containing cadmium, acenaphthene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, phenanthrene, and pyrene
- Human exposure to soil containing benzo(a)pyrene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-35.

### 2.3.33 Revetment 14

The FFS identifies TPH measured as diesel as the COC at Revetment 14, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 14 are to prevent or mitigate potential ecological risk associated with petroleum hydrocarbons (diesel).

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as diesel.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-36.

### 2.3.34 Revetment 15

The FFS identifies metals as the COCs at Revetment 15, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 15 are to prevent or mitigate potential ecological risk associated with metals.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing cadmium
- Exposure of the black rail to soil containing lead

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-37.

### 2.3.35 Revetment 16

The FFS identifies barium as the COC at Revetment 16, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 16 are to prevent or mitigate potential ecological risk associated with barium.

Exposure-specific RAOs are to prevent exposure of the amphipod and algae to soil containing barium.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-38.

## 2.3.36 Revetment 19

The FFS identifies metals, petroleum hydrocarbons, and PAHs as the COCs at Revetment 19, which would pose a risk to human health and ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for Revetment 19 are to prevent or mitigate potential human health and ecological risk associated with metals, petroleum hydrocarbons, and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of algae to soil containing barium
- Exposure of the salt marsh harvest mouse to soil containing copper
- Exposure of the black rail to soil containing lead
- Exposure of the amphipod to soil containing barium, cadmium, TPH measured as diesel and gasoline, 2-methylnaphthalene, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, phenanthrene, and pyrene
- Human exposure to soil containing benzo(a)pyrene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-39.

## 2.3.37 Revetment 20

The FFS identifies metals and PAHs as the COCs at Revetment 20, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 20 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing cadmium, phenanthrene, and pyrene.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-40.

## 2.3.38 Revetment 21

The FFS identifies metals, petroleum hydrocarbons, and PAHs as the COCs at Revetment 21, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 21 are to

prevent or mitigate potential ecological risk associated with metals, petroleum hydrocarbons, and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the salt marsh harvest mouse to soil containing copper
- Exposure of the pickleweed to soil containing vanadium
- Exposure of the amphipod to soil containing TPH measured as diesel and gasoline, 2-methylnaphthalene, and fluorene

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-40.

### 2.3.39 Revetment 22

The FFS identifies petroleum hydrocarbons and PAHs as the COCs at Revetment 22, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 22 are to prevent or mitigate potential ecological risk associated with petroleum hydrocarbons and PAHs.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as diesel and gasoline, 2-methylnaphthalene, acenaphthene, and fluorene.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-42.

### 2.3.40 Revetment 23

The FFS identifies copper as the COC at Revetment 23, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 23 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent exposure of the salt marsh harvest mouse to soil containing copper.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-43.

### 2.3.41 Revetment 25

The FFS identifies barium and petroleum hydrocarbons (diesel) as the COCs at Revetment 25, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were

identified for human receptors at this site. The RAOs for Revetment 25 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing barium and TPH measured as diesel.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-44.

### 2.3.42 Revetment 26

The FFS identifies metals and petroleum hydrocarbons as the COCs at Revetment 26, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 26 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent:

- Exposure of algae to soil containing barium and manganese
- Exposure of bay shrimp to soil containing boron
- Exposure of the pickleweed to soil containing boron
- Exposure of the amphipod to soil containing barium, manganese, and TPH measured as diesel and gasoline

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-45.